POTENTIAL OF A TWO MOTOR CONCEPT FOR ELECTRIC VEHICLES WITH RESPECT TO ITS INTERACTION WITH THE AIR CONDITIONING UNIT

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Two In One Motor (TIOM)

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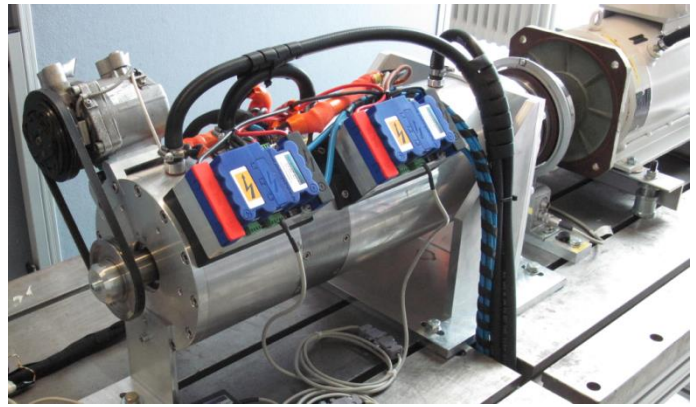
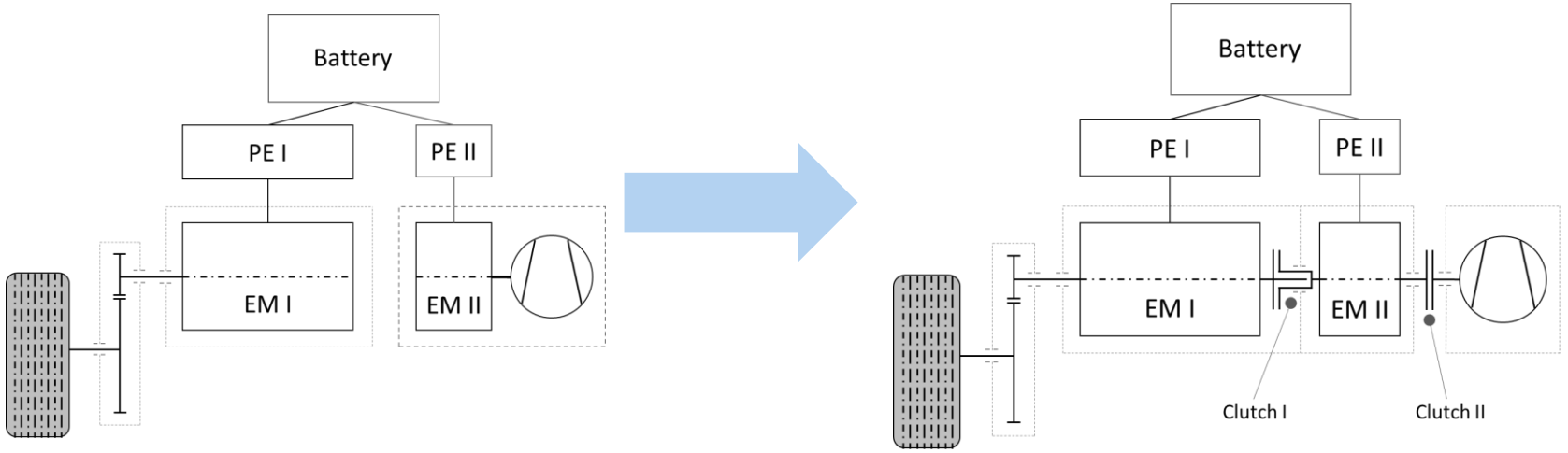


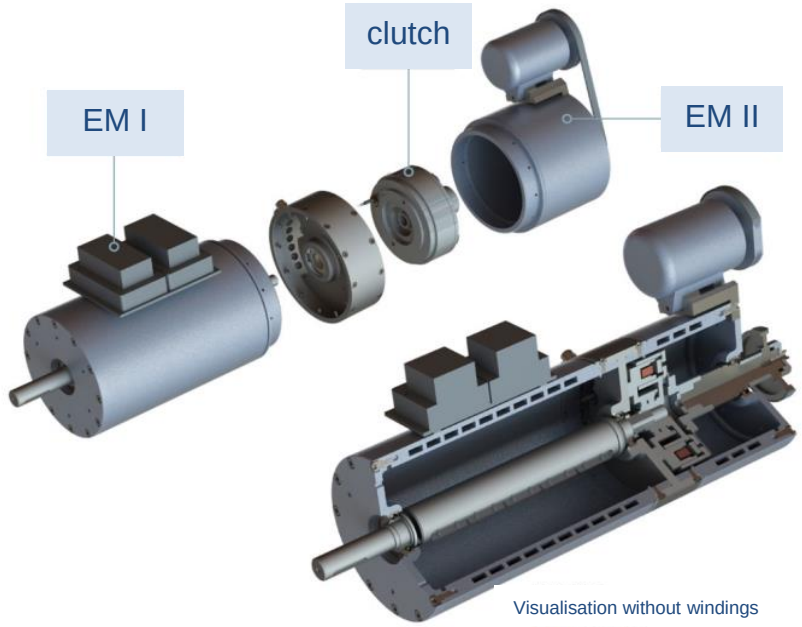
Integration of two electric engines in one compact device

- traction motor: EM I (50 kW)
- motor climatic compressor: EM II (10 kW)



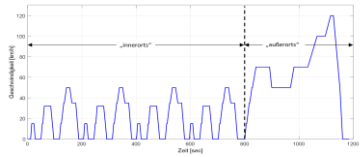
conventional BEV drivetrain

TIOM drivetrain



Visualisation without windings

Vehicle/ driving cycle



vehicle parameter	value
mass	1600 kg
front area	2.18 m²
drag coefficient	0.29
rolling resistance coefficient	0.015

AC system

AC parameter	value
refrigerant	R134a
high pressurre	17 bar
low pressure	3 bar
ambient temp.	30 °C
ambient humidity	60 %

power, rpm

power, max. rpm AC

operation strategy

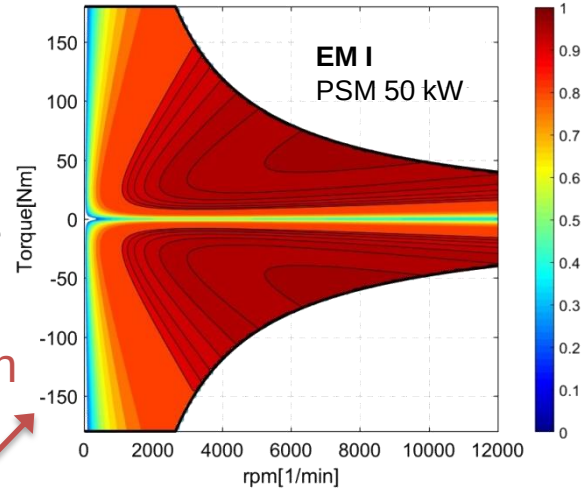
max. power, efficiency

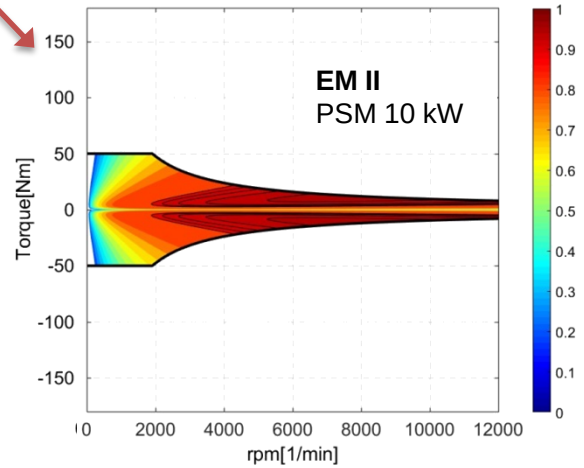
max. power, efficiency

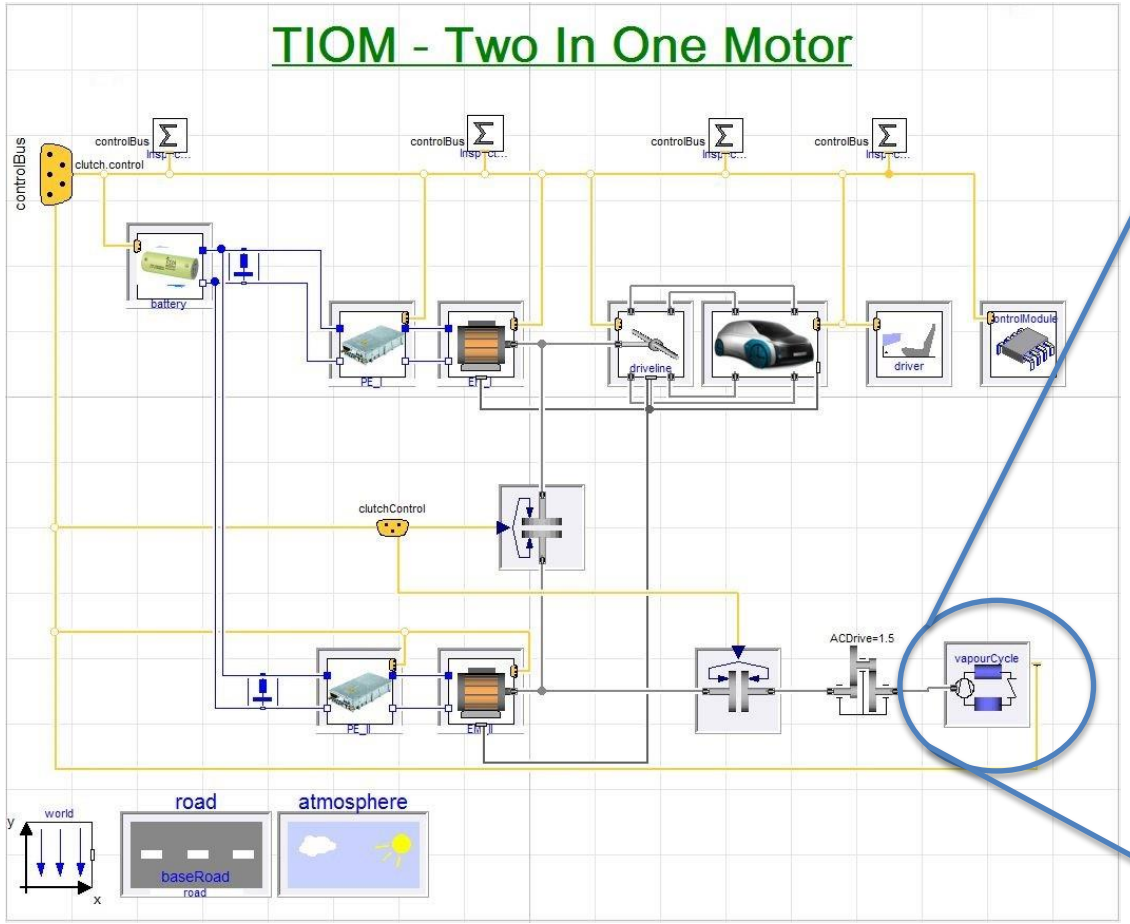
power distribution

select

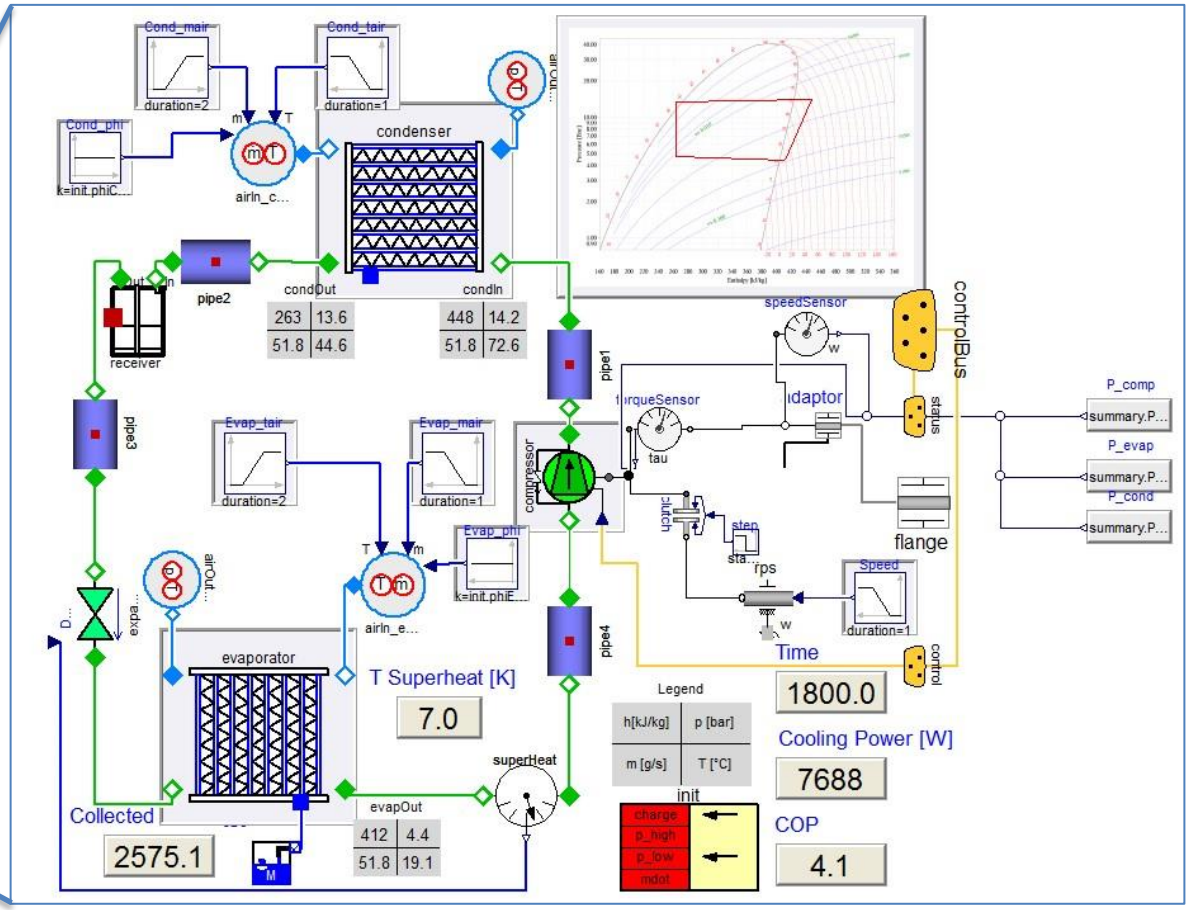
operation modes





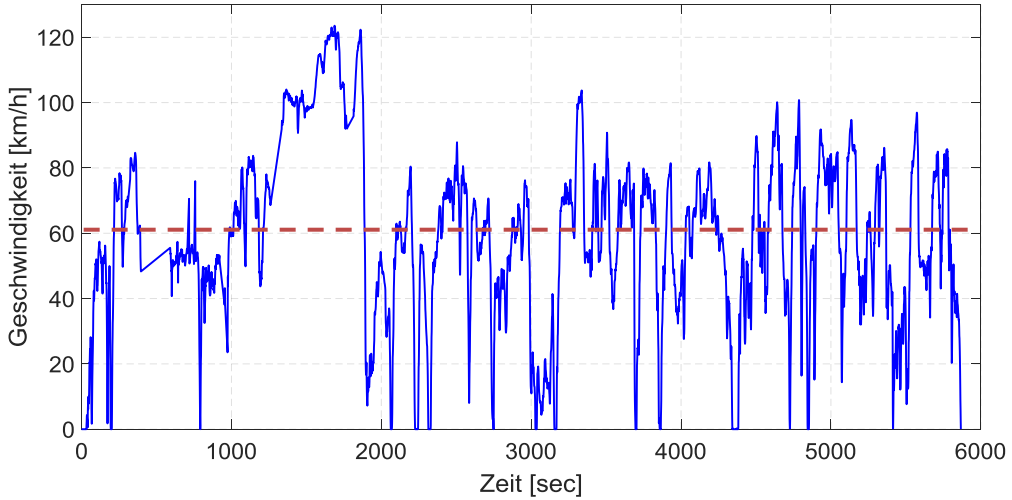


vehicle model

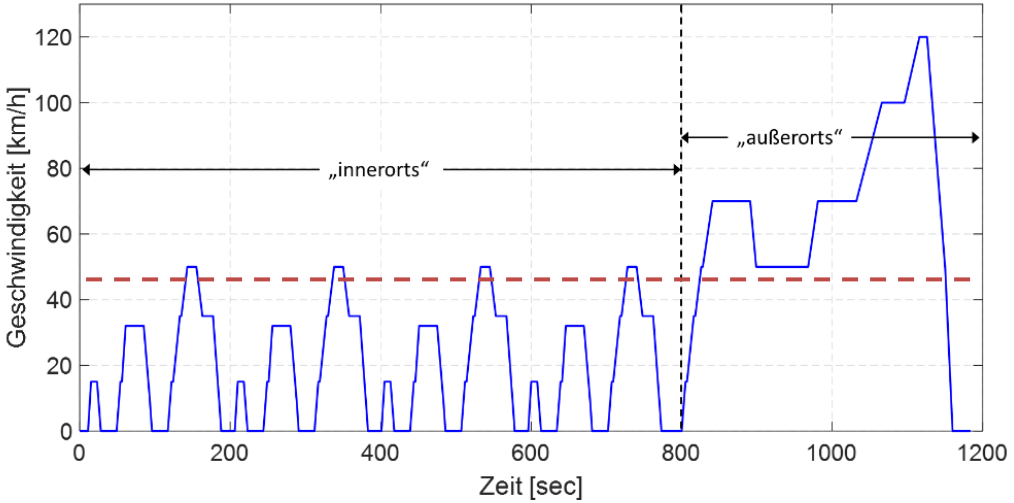


model of the AC circuit

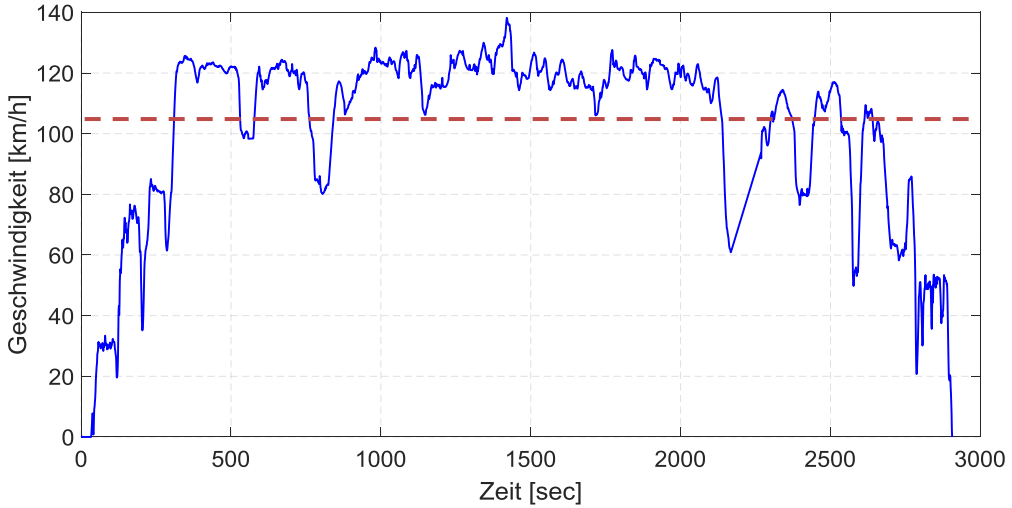
Operation scenarios



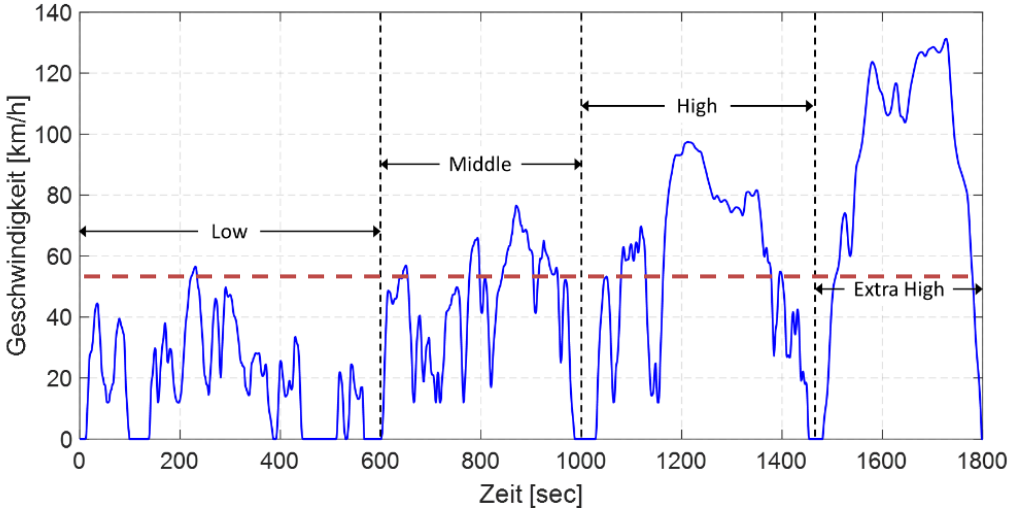
Stuttgart-Lampoldshausen regional (96,140 m)



NEDC (11,013 m)

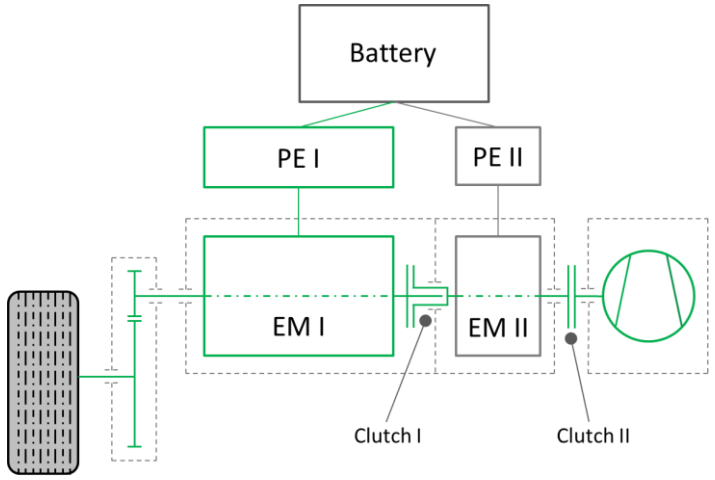


Lampoldshausen-Stuttgart motorway (81,769 m)

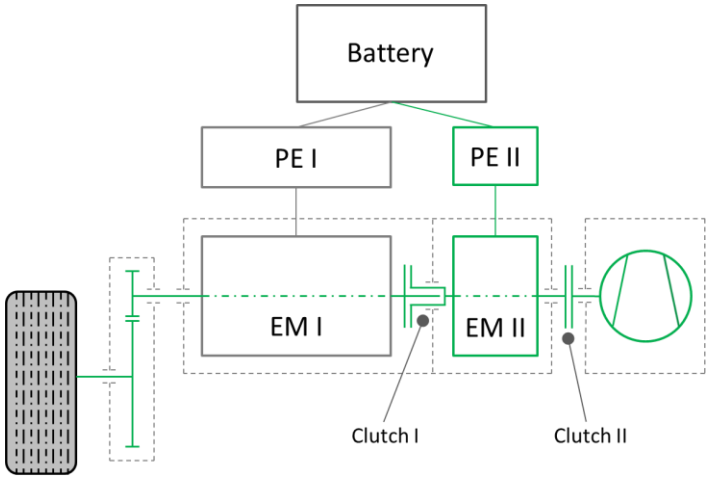


WLTC class 3b (23,266 m)

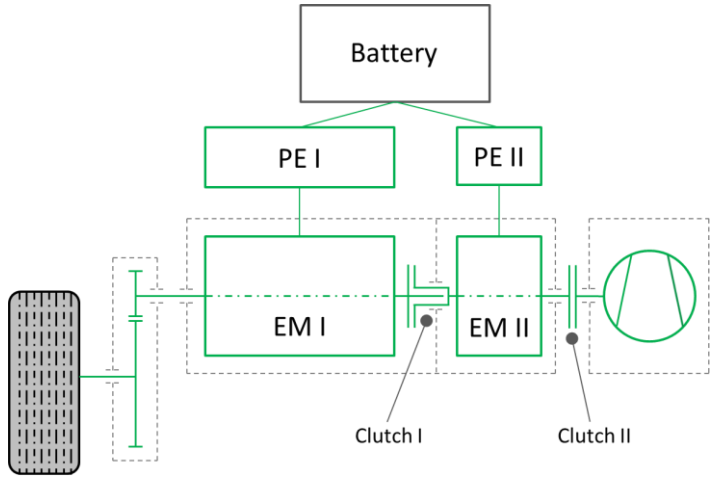
Operation modes



„EMI + AC“
- EMI active / EMII inactive
- clutch I closed / clutch II closed
- Traction /AC from EMI

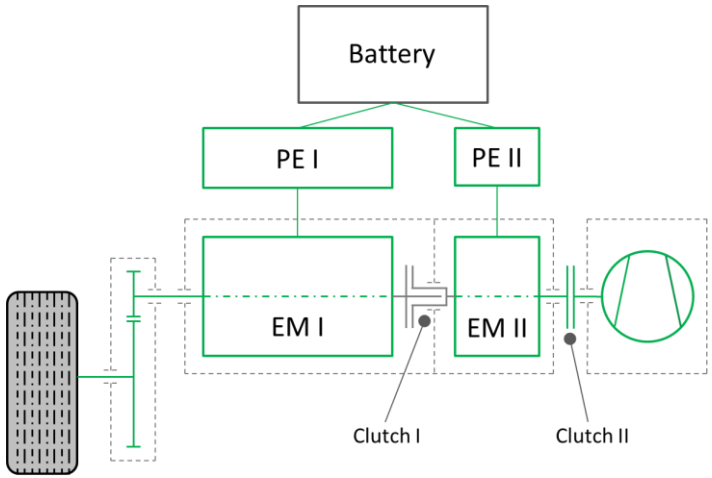


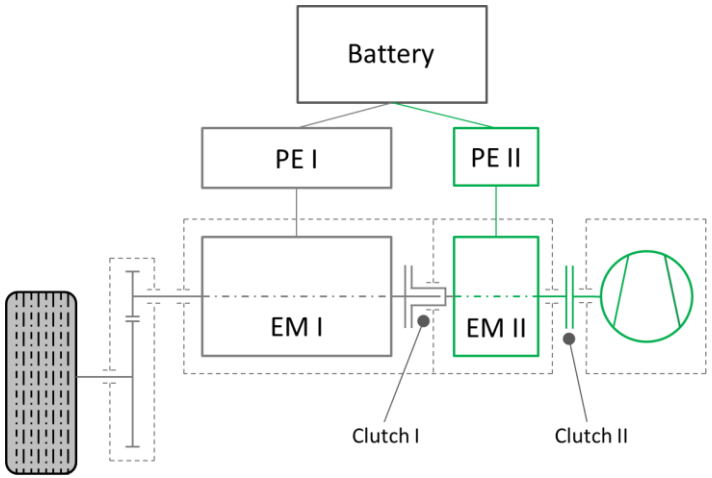
„EMII + AC“
- EMI inactive / EMII active
- clutch I closed / clutch II closed
- Traction /AC from EMII



„Boost+AC“
- EMI inactive / EMII active
- clutch I closed / clutch II closed
- Traction /AC from EMI and EMII

Operation modes (2)





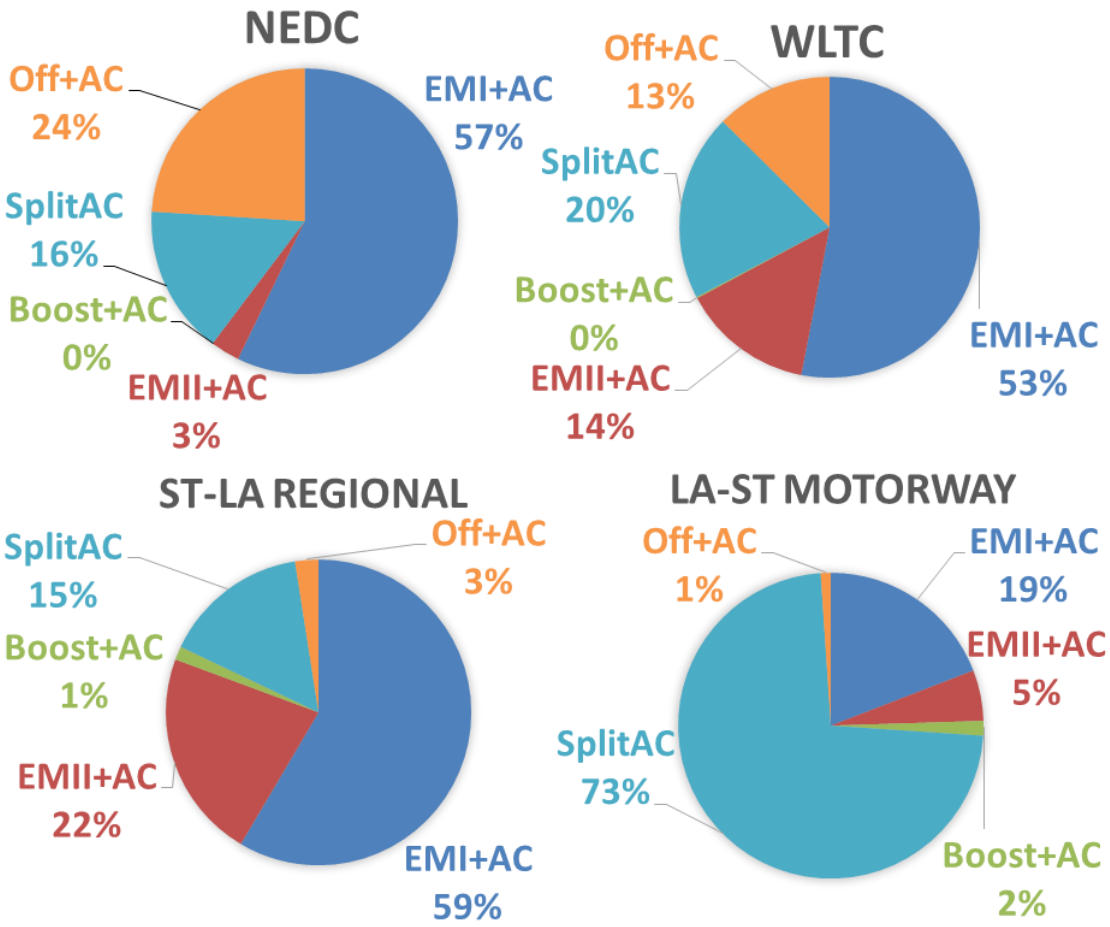
„SplitAC“

- EMI active / EMII active
- clutch I opened/ clutch II closed
- Traction from EMI
- AC from EMII

„Off + AC“

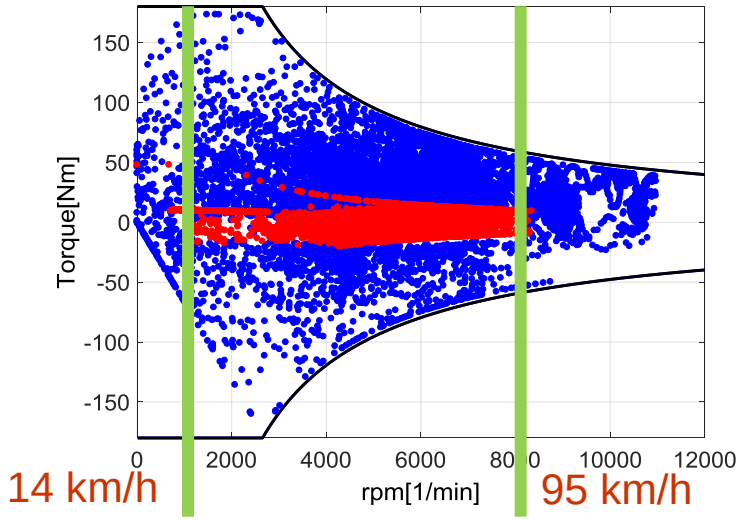
- EMI inactive / EMII active
- clutch I opened/ clutch II closed
- AC from EMII
- vehicle at standstill

Share of the operation modes



energy consumption

drivetrain	Drive Cycles			
	NEDC	WLTC 3b	ST-LA regional	LA-ST motorway
conventional [kWh/100km]	18.21	18.17	15.81	21.54
TIOM [kWh/100km]	17.89	17.84	15.46	21.49
reduction [%]	**1.75**	**1.81**	**2.22**	**0.25**



operation points in ST-LA regional cycle

blue: EMI
red: EMII

- The TIOM drivetrain yields a energy reduction of 2.2% compared to a conventional BEV drivetrain
- The potential could be enhanced when using another compressor
- The highest energy reduction potential is expected in urban an regional driving cycles
- The simulation model is working. Characteristic diagrams of other electric engines could be included.
- The characteristic diagrams of EM I and EM2 will be replaced by using the measured data from the test lab

THANK YOU FOR YOUR ATTENDANCE!

QUESTION AND DISCUSSION

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